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Frog-Egg Eating Tadpoles of *Anotheca coronata* (Stejneger). (Salientia, Hylidae).

BY

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ABSTRACT: Tadpoles of *Anotheca coronata* obtained from bromelias were found to have the upper intestine filled largely with undigested eggs of some species of arboreal frog.

The tadpoles although equipped with a horny beak, ingest the eggs whole. The musculature about the mouth is greatly developed and the intestine unlike that of the typical tadpoles is not coiled, but much expanded and shortened. Labial denticulations are reduced greatly, there being only one complete and one broken series on upper lip, and two series on lower lip.

The species of frog described by Dr. Leonhard Stejneger [1] from Palomo, Valle de Orosi, Cartago Province, Costa Rica, as *Gastrotheca coronata*, was made the type of a new genus *Anotheca* by Dr. Hobart M. Smith.[2] The species was found to be abundant at certain points near Córdoba, Veracruz, Mexico during January, 1938.[3] In Costa Rica, the species has been difficult to find and from the time of its discovery by Dr. C. Picado T. in April 1911 (*fide* Stejneger), no specimen has been reported from that country to my knowledge.[4]

I was fortunate in obtaining two adult specimens of this species in Costa Rica in 1952. One was collected at Moravia de Chirripo by John Baker from low shrubs near a stream, on the night of June 26; the other I obtained from a bromelia, in a felled tree, together with two unusual tadpoles, on June 25, 1952. Three other tadpoles of this type had been found on June 19 in bromelias in another recently

1. Proc. U. S. Nat. Mus., vol. 41, 1911, pp. 287-288.

2. Proc. Biol. Soc. Washington, vol. 52, 1939, pp. 190-191, pl. 1, figs. 1-3 and pl. 2, fig. 6.

3. One was taken Jan. 1; 13, Jan. 3; 43, Jan. 5; 32, Jan. 16.

4. A specimen of frog from Costa Rica, collected by Underwood at Carrillo, Costa Rica, and referred by Günther to the *Nototrema oviferum*, is very young, not yet having completed its metamorphasis. Günther describes it at length and figures the specimen. It seems entirely probable that this is a young *Anotheca coronata* and its discovery antedates that of the type. (See Günther, Biologia Centrali-Americana, Reptilia and Batrachia, Sept. 1901, p. 288, pl. 74, fig. A. (3 figs.).

felled tree, but a large frog also present in the bromelia escaped before its identity could be determined. These arboreal tadpoles were different from most aquatic forms in general conformation, and their lavender, or purplish coloration strongly suggested that they belonged to *Anotheca coronata,* present in the bromelias, since the same colors predominate in the adults of that species.

In the small quantity of water in the bromelias where the tadpoles were taken, there were floating eggs of some frog, which I suspected were those of another species. The tadpoles were semitransparent and the eggs with which their bodies were stuffed, were easily visible, and had been so recently engulfed, that they showed no sign of disintegration. The tadpoles, taken on the 19th some days before, were in water in which no eggs were present, but these too contained many eggs, seemingly recently engulfed. On casual observation they suggested a neotenic tadpole about ready to deposit eggs.

This habit of taking whole frog eggs for food by tadpoles is a somewhat rare occurrence but it has been reported in arboreal frogs of the families Microhylidae and Hylidae. Noble [5] gives an excellent account of this habit in his study on the tadpoles of *Hoplophryne* and *Staurois.*

It would appear that frog eggs are the main article of diet of these arboreal tadpoles but it is still uncertain whether they prey on the eggs of their own species, or on those of other species. All of the larger specimens have the stomachs crammed with new-laid eggs. Even the smallest one, measuring 12.1 mm. in total length, contains 10 eggs any one of which has a diameter equal or greater than the width of its mouth.

The behavior of the tadpoles when first discerned was that of attempted escape and they hid at the base of the leaves of the bromelia. I could not discern that they were more or less active than stream or pond tadpoles. Nor could I determine the reason for the highly developed musculature of the jaws.

Since the eggs seemingly are sucked into the mouth, and not nibbled or cut up by the beak, the muscles must subserve this function at least. Since rains were frequent at the time of my visit the water in the bromelias was not thickened. I did not find gills present in the specimens studied. (See fig. 2B.)

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5. The Adaptive Modifications of Arboreal Tadpoles of Hoplophryne and the Torrent Tadpoles of Staurois. Bull. Amer. Mus. Nat. Hist.; vol. 58, 1929, pp. 291-334, pl. 15-16, figs. 1-10.

I am under obligation to Dr. Grace Orton for certain of the references here given and numerous data of importance to me in this study.

Description of tadpole: Body relatively short, plump, its greatest length (11.6 mm.) exceeding its greatest width (10 mm.); a pair of indistinct dorsal ridges run forward to near nostrils, between them a very slight concavity; between eye and nostril there is a slight

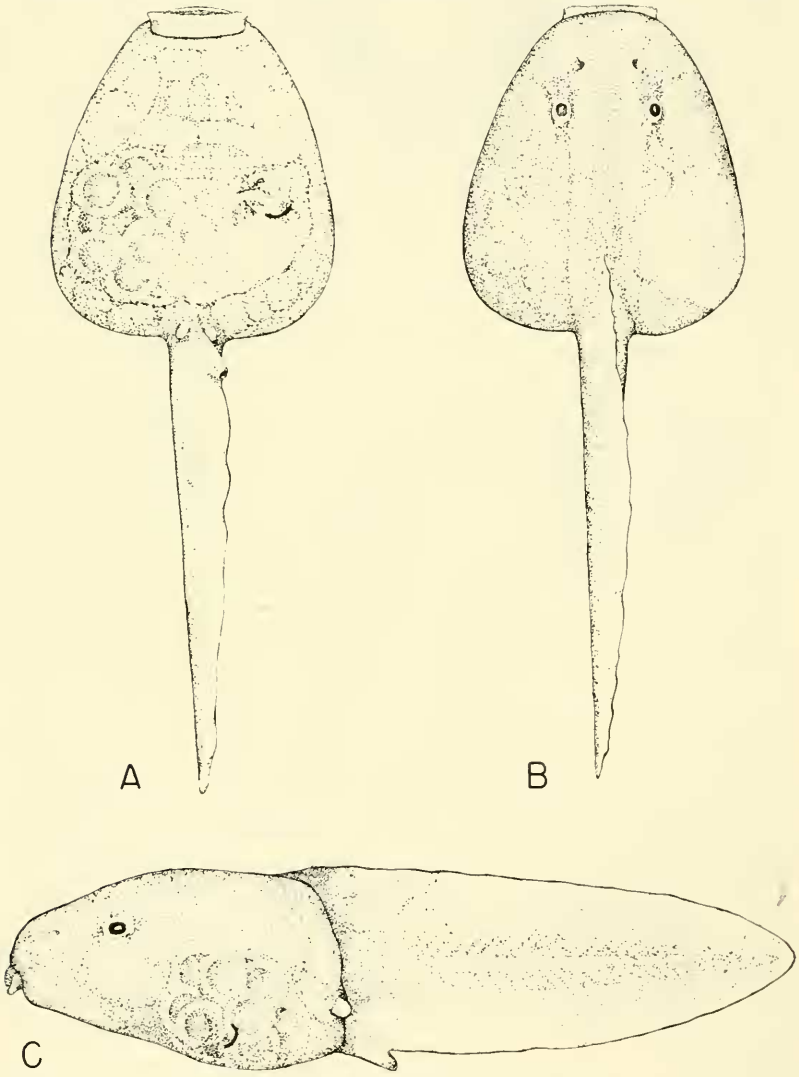

FIG. 1. Tadpole of *Anotheca coronata* (Stejneger). Moravia de Chirripo, Costa Rica. A. Ventral view; B. Dorsal view; C. Lateral view.

lateral elevation; the length of the tail (16 mm.) 2.4 times its greatest depth; musculature of the tail rather strongly compressed laterally, the myotomes more or less distinctly visible; eyes dorsal, moderately large, set wide apart (2.8 mm.), the distance between them less than their distance from anterior level of snout (3.1 mm.); distance between nostrils (2.4 mm.) equal to their distance from anterior level of snout; seemingly a somewhat depressed area lateral to the nostril; dorsal tail fin inserts on posterior part of body and attains its greatest elevation near the base of the tail; it narrows slightly and save where it rounds the tip, maintains approximately the same elevation (approx. 2. mm.).

Vent opens through a short tube, directed dextral; a pair of limb buds visible on each side, .8 mm. in length. Spiracle sinistral, lateral, the opening semilunar in shape, its distance from anterior level of snout 1.5 times its distance from posterior level of body.

Mouth surrounded by a continuous free flap, papillate on its outer edge, upper part slightly less elevated than lower, their edges closely approximated in a straight transverse line (appearing like a pair of lips), concealing from view tooth-rows and beak. On inside of upper lip, there is a single elongate row of denticles, behind which (or below) on each side is a very short, somewhat curved row; on inner side of lower lip are two transverse rows of denticulations, the outer somewhat sinuous, the inner nearly straight. The upper and lower parts of the beak are moderately heavy and denticulations are very fine and numerous, scarcely visible without examination under a lens.

The musculature of the head is conspicuously and strikingly developed. In ventral view the submaxillaries appear as two thick plump muscles touching the anterior end of the ceratohyo-angularis; the subhyoideus is slenderer and somewhat more elongate than the submaxillarius; the geniohyoideus is a thin elongate muscle separated from its fellow by a distance equal to its width. Laterally the musculature is somewhat massive. The temporalis is large and partly overlain by the eye. Below, the large thick orbitohyoideus lies partly covering the lower part of the temporalis, and the posterior end of the adductor mandibulae posterior subexternus, the suspensorio-angularis, and the ceratohyo-angularis. (See fig. 2C, 2D.)

Color: Dorsally the general color of the tadpoles is a purplish lavender, which extends to the end of tail, although less dense

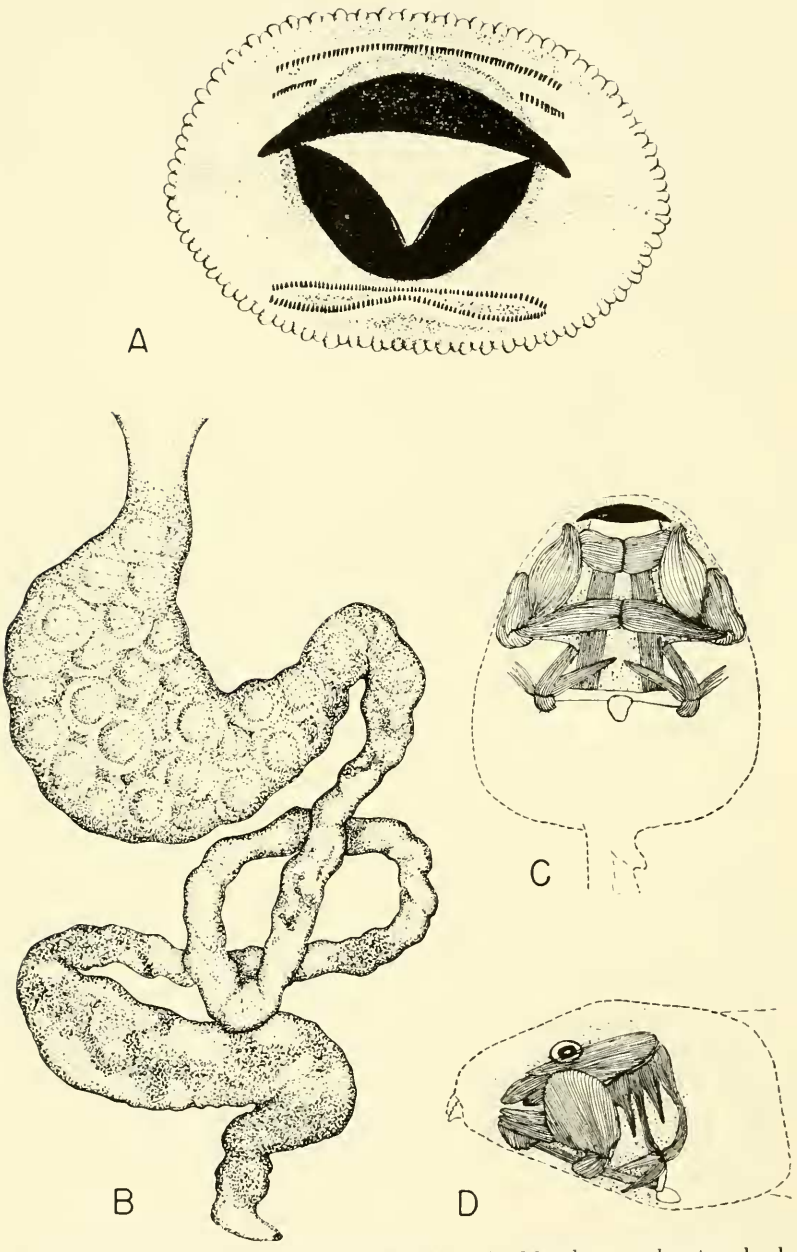

FIG. 2. Tadpole of *Anotheca coronata*. A. Mouthparts showing beak, and labial denticulations (lips stretched open). B. Stomach and intestine, displaced to show length. C. Musculature of the head, ventral view; D. Musculature of head, lateral view.

there. The young specimen had the color more lavender and of a lighter shade.

Measurements in mm. of a tadpole of Anotheca coronata.

Length of body greatest	11.6
Greatest width of body	10
Greatest height of body	6.6
Eye from tip of snout	3.1
Distance between eyes	2.8
Eye to nostril	1.7
Nostril from tip of snout	1.4
Distance between nostrils	2.4
Diameter of eye	.5
Total length	27.5
Tail length	16.0
Height of dorsal tail fin (greatest)	2.05
Height of ventral fin (greatest)	1.95
Spiracle, from level of snout	6.8

Remarks: The lack of sufficient specimens from the southern part of the range of *Anotheca coronata* has made it impossible to evaluate the differences between the northern, Veracrucian, and the southern, Costa Rican, populations. There is seemingly a hiatus in the range of this species from the Meseta Central of Costa Rica to central Veracruz (region near Cordoba) a distance of approximately 1,100 miles. That discontinuity in range is an actuality in the intervening areas may be doubted but the fact remains that no specimens have been collected there. Careful collecting, however, may prove their presence.

The observable differences in my two Costa Rican specimens and those from Veracruz (all females) show the northern form with a troughlike depression on the snout between the strongly elevated canthi, while southern forms have the canthi scarcely elevated the top of the head and snout nearly flat. In northern forms the eyes are perceptibly larger and the circumorbital spines strongly elevated with a narrower interorbital region. The occipital region enclosed by spines is distinctly less in area. The hind legs are shorter, the tibiotarsal articulation reaching just in front of eye, while in the Costa Rican specimens it reaches to nostril or end of snout, and the fingers and toes are distinctly longer in specimens of equal snout-to-vent length. The color and markings are as follows:

In life the specimens from Costa Rica were purplish black with gray above; the dark leg-spots edged with cream, or on under sur-

face, with white; chin and throat with a conspicous brown area; lips and canthi edged with gray; venter and underside of limbs dark grayish lavender with a few white fleckings; palms and soles grayish black. In preservative they have become slate color above and below on abdomen. The limbs still show some lavender; the chin and throat are brownish.

FIG. 3. *Anotheca coronata* Stejneger K.U.M.N.H. No. 31860, Moravia de Chirripo, Limón Prov., Costa Rica. Actual snout-vent length, 62.5 mm.